The Jabal al Usayfir quadrangle, sheet 26/40 C, is located approximately 195 km southwest of the regional center of Ha'il, in the north-central part of Saudi Arabia, and is bounded by lat 26000' and 26030' N., and long 40000' and 40000 E. Access is via the Al Madinah - Ha'il paved highway to Hulayfah or Ghazzalah, thence by unimproved road to Zarghat, located a few km from the northeastern corner of the quadrangle. Desert tracks lead from Zarghat to the rest of the area, but a large expanse of the area is underlain by Tertiary to Recent Harrat Ithnayn, and is impassable to land vehicles.

The area has low relief, broken by low hills and mesas of Proterozoic and Paleozoic rock, basalt, cinder cones, and Jabal al Usayfir. Drainage in the quadrangle trends generally to the east and southeast, but rainfall is low. The climate is typical of inland Saudi Arabia, with summer day temperatures reaching 45-50° C., and with generally cool nights. Temperatures can reach 0° C. in winter. Vegetation is sparse.

#### The area is sparsely populated, and permanent water is found only in wells. PREVIOUS AND PRESENT WORK

The Jabal al Usayfir quadrangle was first mapped by Brown and others (1963) as a part of the Northeastern Hijaz quadrangle (scale 1:100,000), and the eastern part was included in the reconnaissance photogeologic map of the Hulayfah-Zarghat area mapped by Bowden (1982). Quadrangles to the east, north, and west were mapped by the U.S. Geological Survey Saudi Arabian Mission at a scale of 1:100,000. The quadrangles to the south were mapped by the Bureau de Recherches Geologiques et Minieres. The author mapped in reconnaissance at a scale of 1:100,000 during the month of May, 1983.

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# GEOLOGIC SETTING

The rocks and structures of the northern part of the Arabian Shield were formed as the result of a large, west-directed, convergent tectonic event that spanned over 500 million years and ended about 550 Ma ago. During this time a large ocean basin, located to the east of the large continental mass of the African craton, was consumed along a series of island-arcs. About 660 Ma, a continental mass impinging from the east collided with the Arabian Shield forming the Nabitah orogenic belt (Stoeser and Camp, 1984) along suture zones marked by ultramafic rocks. Continued compression caused the formation of acidic plutonic rocks and the eruption of rhyolitic volcanic rocks. Near the end of the Proterozoic era, the Arabian Shield failed under compression along the Najd sinistral shear-fault system. Coarse, blanket-like sandstone of the Siq member of the Cambrian Saq Sandstone covered all of the Proterozoic rocks until they were partially stripped by erosion, then covered by Tertiary to Recent basalt flows and cinder cones.

# PALEOZOIC ROCKS

Coarse, blanket-like sandstones of the Siq member of the Saq Sandstone covered all of the Proterozoic rock until partially stripped by erosion and covered by Tertiary to Recent basalt vents and flows.

Troctolite intrudes Proterozoic rocks and crops out near the eastern edge of Harrat Ithnayn. It is thought to be the hypabyssal intrusive equivalent of picritic lavas extruded near the beginning of basalt eruption.

# SURFICIAL DEPOSITS

Deposits of alluvium and colluvium derived from underlying rocks partly fill the valleys in the quadrangle.

# STRUCTURE

The predominant structures of the Jabal al Usayfir quadrangle were caused by shearing, faulting, and folding during the late Proterozoic Najd event during which a maximum compressive stress was aligned approximately east-northeast. Associated tension fractures, commonly filled with quartz, silicate, or granitic dikes, strike approximately N. 70°-80° E., and sinistral shear faults strike N. 65°-75° W. These structural orientations are exhibited by all of the pre-Najd-age rocks.

Pre-Najd structures of the Hulayfah group rocks were the result of the collision of a continental plate (Stoeser and others, 1984) impinging from the east, that caused north-northeast-trending, west-directed, subduction-related thrust faults and associated suture zones. Folds associated with this collision event are assymetrical, having gentler east dips than west dips, and north-northeast-trending axial traces that plunge at low angles to the south.

# **ECONOMIC GEOLOGY**

No evidence of minerals having economic values was discovered in the quadrangle.

# DATA STORAGE

Petrographic descriptions, sample locations, thin sections, and results of chemical analyses, are stored in Data-File USGS-DF-04-38 (Fairer, 1984) in the Jiddah office of the U.S. Geological Survey Saudi Arabian Mission.

No Mineral Occurrence Document System (MODS) localities were established.

# PROTEROZOIC SEDIMENTARY, VOLCANIC, AND METAMORPHIC ROCKS

The Proterozoic layered rocks of the quadrangle can be divided into two main assemblages: (1) the Hulayfah group (780-680 Ma), which consists of mafic to intermediate volcanic rocks and subordinate sedimentary rocks, which formed in the island-arc environment; and (2) the Shammar group (630-570 Ma), which consists of intermediate and rhyolitic volcanic rocks and arkosic sediments that are intracratonic in character.

#### HULAYFAH GROUP

The oldest rocks in the quadrangle belong to the Hulayfah group (Delfour, 1975a), an assemblage of andesite and andesitic tuffs overlain by, and interfingering with, andesitic graywacke and marble. These rocks were formed as a part of the Hulayfah island-arc (Stoeser and others, 1984). Deposition in the arc ceased with the onset of the collision with the eastern continental plate about 680-630 Ma, during which period the rocks of the Nabitah orogenic belt (Stoeser and Camp, in press) were formed.

#### SHAMMAR GROUP The Shammar group (Brown and Jackson, 1960), is represented in the quadrangle by

rocks of the Kuara and Usayfir formations.

Kuara formation The Kuara formation (Delfour, 1975b), a conglomerate comprised of clasts the

provenance of which the underlying Hulayfah group and plutonic rocks, is correlated with unmapped basal conglomerate lenses that occur at the base of the Zarghat formation in the Ash Shamila quadrangle (Fairer, 1985). The Kuara underlies the Usayfir formation at the northern edge of Jabal al Usayfir.

# Usayfir formation

The Usayfir formation, here named for Jabal Usayfir, is comprised of unconsolidated conglomerate consisting of, spherical boulders of rhyolite and quartz porphyry. This formation is distinguished from the underlying Kuara formation by the absence of clasts of Hulayfah group provenance.

# PROTEROZOIC INTRUSIVE ROCKS

Hypabyssal granite, gneiss, biotite granodiorite, quartz diorite, dacite, biotite monzogranite, biotite granite, hornblende granite, biotite-hornblende granite, and quartz diabase, intrude rock of the Hulayfah group at various stages.

Deposition of the Shammar group was preceded by, or was contemporaneous with, intrusion of alkali-feldspar granite or quartz porphyry.

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